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THE VALUE OF INDIVIDUAL FACILITIES

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Presented by James B. Coulter

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Even though the role of the septic tank is subordinate to to that of the disposal field, for ease of reference, the method of on-lot disposal of sewage by soil absorption will be referred to as the septic tank system.

The widespread use of the septic tank came as a result of an unprecedented demand for housing in suburban areas. Before attempting an evaluation of the septic tank as a means of sewage disposal, it would be well to review the factors promoting its use. The review should give consideration to the house building industry and to the forces that govern the activities of that industry. After a long freeze during the war, construction got underway in the late 1940's, and we witnessed a mass movement of population to the suburbs. There may have been reason to believe that this shift in population resulted from the back-log in housing demand; that eventually construction would catch up with demand leaving a relatively stable community with a new outer boundary; and that permanent facilities would be installed to replace the temporary devices used during the expansion period.

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It now appears that this reasoning was in error. For one thing, there was no way of predicting the tremendous increase in the birth rate following the war. In 1940, the consensus of opinion was that the population of the United States would become stationary and perhaps even begin a decline. Even as late as 1946 a population of 153 million was forecast for 1960, and an ultimate peak of 164.5 million was predicted for 1990. The great increase in marriages and births following the war make these predictions appear ridiculous. The present population is in excess of 166 million and an estimate of 180 million now seems logical for 1960. In fact, during the past 10 years population increase has consistently exceeded the estimates.

The number of immediate housing starts is more nearly associated with new family formations than with population increase. The formation of new families is sagging at present because marriageable people are now being drawn from the low birth rate years of the depression, but the high birth rate after the war will result in a wave of population in the marriageable age commencing in the late 1960's. We can see that wave of children passing through grade school now. In a few years they will be in high school, later in college, and then into prospective marriage and home ownership. The median age of women at first marriage is 20.1 years. In 1975 there will be roughly twice as many women age 20 as there were in 1955.

Family income is another factor that greatly influences house building and home ownership. In spite of increases in the cost of housing, a rising family income has brought home ownership within the reach of a large portion of the nation. The percentage of owner-occupied dwellings rose from 43.6 percent in 1940 to 55.0 percent in 1950, and a further increase to 60.0 percent is predicted for 1960. In addition, there is good reason to believe that a rising family income coupled with modern financing will lower the age at which homes are first bought.

Considering these facts, it is believed that housing starts will continue at the present rate of approximately 1,000,000 per year for the next four years. After that there will be a steady increase in the number of starts with the possibility of 2,000,000 or more per year in the 1970's.

The location of new housing in regard to the central city is of extreme importance to us in our consideration of fringe area sanitation. According to the Current Population Survey, practically all of the population increase from 1950 to 1955 was registered in the 168 standard metropolitan areas. The trend is expected to continue. To be realistic we must conclude that the limits of the parent cities are virtually fixed by the will of the people. Building sites within the corporate limits served by a sewerage system are already scarce and priced out of the speculative house-building market. Therefore, the vast majority of

new houses will be built in the suburbs at an ever increasing distance from the parent city.

In this respect, the highway building program will have more impact on housing location than any other factor in history. Approximately 40 billion of the estimated 100 billion dollars to be spent on roads in the next decade will be channelled into metropolitan areas. As a result, limited access expressways will lead from the outskirts into the heart of all major cities. As time and not distance is the major consideration of commuters, the expressways will make land available and attractive for housing at great distances from the city. Construction of the highways themselves will generate pressure for the suburban movement. One noted economist has estimated that 300,000 to 400,000 houses per year demolished in the highway and urban renewal programs will have to be replaced and relocated. Although the estimate appears high, it is undeniable that demolition of houses is a factor in forcing people to the surburbs.

With the highways will come restaurants, motels, shopping centers, and other service installations. Industries will also locate along the highways generating still further pressure for fringe area housing. All of these will require sewerage and other community facilities and intensify the problem.

A cold appraisal of these facts and trends leads to a very sobering conclusion. The expansion of standard metropolitan areas is not a passing phase. Rather, we have seen the start of a

trend that may continue into the 1980's. To provide for adequate sanitary facilities of all types in a dispersed community such as that visualized is something for which we are entirely unprepared. The problem of sewage disposal is already acute. In fact, to provide for the proper disposal of sewage in an expanding suburban area from the time the first house is occupied until the area is fully developed is perhaps the most complex problem ever faced by the sanitary engineering profession.

It is true that other disciplines are involved, but the basic responsibility for providing essential sanitary facilities is ours. Unless we seize the initiative and establish strong leadership, the situation will continue to deteriorate and confusion will continue to increase. There is a glaring gap in our technical knowledge between on-lot disposal at one end of the spectrum, and the large collection system and central sewage treatment plant on the other end. We have a few years before the increase in housing production, and the influence of the highway program are felt. Late as it is, we must take immediate steps to see that our plans, our philosophy, and our technical knowledge are geared to a changing pattern of community development. We need to investigate schemes that will safeguard public health and that are both compatible with the economics of the building industry and the desire of the people for home ownership in suburban areas.

Coming back to my specific subject, under the proper circumstances, the septic tank system can be a satisfactory means for disposal of sewage in a developing suburban area. Its use is subject to a number of stringent conditions which must be met if extremely unsatisfactory results are to be avoided. When properly used, the system has the following advantages:

1. Sewage treatment is complete; the effluent is disposed of on each lot, and each home owner is responsible for his own system.
2. The method is compatible with both the pattern of construction in the United States and the requirements of health authorities.
3. In the over-all plan, sufficient capacity to serve each home is added as the house is built.

The conditions under which a septic tank can be used satisfactorily have been determined. These conditions have been reported in a number of technical publications, but they are only beginning to be applied with any force at the state and county level. It is anticipated that general application of these recommendations will result in, first, the rejection of the septic tank system where it will not work; and second, a tremendous reduction in the number of complaints stemming from malfunctioning systems. Of almost equal importance, if a system has been installed under proper conditions and has failed due to misuse, lack of maintenance, or old age, the failure can be corrected at the expense of the home owner.

In brief, the conditions that must be met to insure satisfactory performance can be summarized under soil, design, construction, and use.

Of these factors, the soil is the most important and the one over which we have no control. To be useful for subsurface disposal of sewage from a large number of homes there must be at least 5 feet of cover between the bottom of the disposal field and rock or other restraining formations; the ground water table must be at least 4 feet below the surface of the ground; and the soil must have a sustained percolation rate that is acceptable. For isolated dwellings it may be possible to shade some of these requirements, but for subdivisions all of them must be met. Unfortunately, over half of the soil in our country is unsuitable. Furthermore, unsuitable soil is apt to be found on high ground desirable for house building, while suitable soil is likely to be found in the bottom-land desirable for agriculture. In that no practical method of improving soil for this purpose has been found, the wise builder has learned to make a preliminary investigation before purchasing a tract of land for housing development.

Design starts with the capacity of the system. With increasing water consumption and modern appliances, the concept of increased tank capacity has been readily accepted. Surprisingly, there has been resistance or at least apathy to the need for increasing the absorption area even though it is in the field that

disposal of the daily volume of liquid is accomplished. The relationship between soil area and life of the system is difficult to convey, but nevertheless, it exists. Each year an increment of the available area is exhausted and becomes impervious. When the remaining area will no longer absorb the daily daily volume of liquid the system fails. In a 60-minute soil, a 3-bedroom modern house requires approximately 1000 feet of design area. Few recommendations set that type of standard. Location, layout, grade and details of construction are also essential to good design; and for the most part, are adequately covered in present recommendations.

Careful construction is as important as good soil. Good construction can't improve the soil, but good soil can be ruined by poor construction. Within my experience most instances of early failure of well designed systems in good soil could be traced to improper construction. Perhaps the worst offense is working the soil when it is too wet. Surfaces are smeared and effectively sealed before any sewage is applied to the system. Walking or working in the trench will compact and seal the surfaces. It is recommended that the trench sides and bottom be raked when the soil is relatively dry and that all loose soil be removed before the gravel is laid in the trench. Another common fault is to set the distribution box so that most of the liquid goes to one trench. This is especially severe and will

always lead to failure on sloping ground where there is no opportunity for the overloaded trench to relieve itself other than through surface seepage. In some instances the box has been set correctly and disturbed later by a truck or other piece of heavy equipment running over it. There have been many instances where open trenches were improperly protected during rainstorms and surface water carrying its load of silt was permitted to run into them. Another common fault is to permit roof drainage or other storm water drainage to run over the surface of the disposal field. Wet weather failures can often be traced to these causes. An assortment of articles including tools, rags, lunches and gloves have been removed from the house sewer. A common mistake is to set the septic tank backwards. The inlet baffle is sometimes broken off or only a narrow crack is left for sewage to pass when the house sewer is pushed too far into the tank. The list of construction deficiencies could run into a full scale treatise, but fortunately, practice has improved tremendously in the past few years, and it is continuing to improve.

Even with good soil, design, and construction, the home owner can misuse his system and cause it to fail. Through wasteful water use or the addition of appliances the system can be overloaded to the point of failure. Maintenance is simple, but essential for a long period of good performance. The tank should be inspected annually and cleaned before sludge is carried to the

disposal field and damages the soil. If the lot is of sufficient size and the septic tank is located properly, failures produced by abuse of the system can be corrected by installing a new disposal field. This is of course expensive, and when once informed of the danger and expense, the home owner is usually very cooperative.

The septic tank should never be used where conditions are improper for its successful operation. Contrary to all too frequent practice, the septic tank is a poor temporary device or interim facility. In many instances, septic tanks have been permitted in soil where there was little, if any, chance for successful operation, on the assumption that adequate sewerage service would be provided as soon as the population density reached the point where it was practical. Although in theory the temporary use of septic tanks may appear attractive, there are practical considerations that work against the plan. Some of these considerations are listed.

1. Immediate failures will create nuisances and public health hazards.
2. Many home owners, fearing the effect on property values, will refuse to admit that failures are occurring, and they will not support remedial action on a community basis.
3. Not all systems will fail at the same time and it is

difficult to get the ones who are not having trouble or who have recently spent sizeable sums to repair their systems to agree to community action.

4. There will always be resistance to bond issues and higher taxes. In addition to the expense, the inconvenience entailed in tearing up streets and lawns will stall action until the situation is extremely critical.
5. The expense of installing a collection system in an established neighborhood is several times that for the same system in raw land.

Other methods of interim treatment that will protect public health should be devised in which the collection system is installed when the houses are constructed, thus eliminating the double expense.

A strong, well-organized health department is needed to prevent abuses with the septic tank system. A good ordinance should define the soil conditions suitable for septic tanks, require enough useable area on each lot for two complete disposal fields, empower the proper authority to establish minimum requirements for both septic tank and disposal field, require an approved permit before construction starts, require individual design and construction by competent, responsible, authorized parties, and require a final inspection of the system before it is covered.

The regulation should set forth the soil prerequisites for use of a septic tank system. A reliable percolation test is time consuming and requires great attention to detail. Some health departments feel that the evaluation of land is not a function of government but part of the engineering services to be borne by the developer. For that reason, a number of county departments require that every application for a septic tank permit be accompanied by a log of the subsoil and results of percolations tests performed under the direction of a licensed professional engineer or other equally responsible person.

The regulations should also specify the minimum available area that must be provided on each lot for the disposal field. In general, this is better practice than specifying lot size, as often the shape of the lot, the location of the house and driveways, and undesirable terrain features make it difficult to find a suitable location for the absorption field even on large lots. The areas reserved for the system should be large enough to provide for complete replacement of the disposal field if it should become necessary. The area shown in the following table will, in general, be sufficient, but the builder should demonstrate that two disposal fields can actually be placed in the designated area on the lot. The following table is computed using a 10-foot perimeter around the disposal field, 6-foot spacing center to center between trenches, and 20 feet from the house to disposal

field to provide for the tank and distribution box.

Minimum Area to be Reserved
On a Lot for a Septic Tank System

Percolation rate min./inch	Trench 2 ft. wide per bedroom ft.	Area needed for system 2-BR home sq. ft.	3-BR home sq. ft.	4-BR home sq. ft.
10	85	4,400	5,800	7,200
20	105	5,000	6,900	8,500
30	125	5,800	7,800	9,700
40	143	6,300	8,500	10,800
50	158	6,900	9,300	11,800
60	165	7,200	9,700	12,300

At the county level the authority to issue permits is sometimes in the health department and sometimes in the building department, but invariably complaints are handled by the health department. Where dual authority and responsibility exist, it is essential that the two departments work in close cooperation to see that no permit is issued unless the soil conditions are satisfactory and unless the system is designed in accordance with the regulation.

Inspection is necessary to see that the system was constructed in accordance with the permit and that good construction practice was used. In this regard there have been instances where the builder was required to remove tile and rock and rework trenches to remove smeared and sealed surfaces. It is necessary to check the provisions for storm drainage, the house sewer for stoppages, the tank inlet for clearance, and the distribution box for level as well as the capacity and construction details of tank and disposal

field. Most counties prefer to have their own men make the inspection. The system should be covered as soon as the inspection is completed to protect it from rain and accidental damage.